

1.4938/X12CrNiMoV12-3 represents a premium martensitic [stainless steel](#) specifically developed for critical high-temperature applications in turbines and aerospace. Its balanced composition provides an excellent combination of strength, creep resistance, and corrosion resistance at temperatures up to 600°C. The strict quality control requirements across OEM specifications ensure reliable performance in demanding applications.

Austenitic [stainless steels](#) for turbine applications offer exceptional high-temperature strength, creep resistance, and corrosion resistance in demanding environments. This guide provides a comprehensive technical analysis of three important grades: 1.4962 (X12CrNiWTiB16-13), St17-13W (GE specification), and their equivalents.

Applications

X12CrNiWTiB16-13 / 1.4962 Applications

- **Classification:** Austenitic stainless steel with titanium and boron stabilization
- **Applications:** Gas turbine blades, combustion components, high-temperature fasteners
- **Key Features:**
 - Excellent creep resistance at temperatures up to 750°C
 - Good oxidation resistance
 - Typically supplied in solution annealed condition (+A)

St17-13W (GE Specification) Applications

- **Classification:** Warm-worked austenitic stainless steel (GE proprietary)
- **Applications:** Critical rotating components in gas turbines, especially GE designs
- **Key Features:**
 - Enhanced strength through warm working
 - $R_{p0.2} \geq 440$ MPa in warm-worked condition
 - Optimized tungsten content for creep resistance
 - Typically supplied in warm-worked condition (+HT)

Equivalent or Similar Grades - Chemical Composition

Element	X12CrNiWTiB16-13 / 1.4962	St17-13W (GE NB 00144)	Similar Grades
C	0.08-0.16	0.08-0.15	0.08-0.20
Si	≤1.00	≤0.80	≤1.00

Element	X12CrNiWTiB16-13 / 1.4962	St17-13W (GE NB 00144)	Similar Grades
Mn	≤2.00	≤1.00	≤2.00
P	≤0.045	≤0.035	≤0.045
S	≤0.015	≤0.005	≤0.015
Cr	15.0-17.0	15.50-17.50	15.0-18.0
Ni	12.0-14.0	13.00-14.50	12.0-15.0
W	2.0-3.0	2.50-3.00	2.0-3.5
Ti	5×C min, ≤0.80	5×C min, ≤0.85	5×C min, ≤1.00
B	0.003-0.010	≤0.0060	0.003-0.010
Mo	≤0.50	≤0.50	≤1.00
V	≤0.10	≤0.10	≤0.20

Note: St17-13W has stricter sulfur control (≤0.005%) compared to standard grades

Mechanical Properties

Room Temperature Mechanical Properties

Property	1.4962 / X12CrNiWTiB16-13	St17-13W (GE Spec)
0.2% Proof Strength (MPa)	240-400 (+A)	440-650 (+HT)
Tensile Strength (MPa)	540-740 (+A)	≥590 (+HT)
Elongation A5 (%)	≥35 (+A)	≥20 (+HT)
Impact Energy (J)	≥80	≥70
Hardness (HB)	160-220 (+A)	180-240 (+HT)

High-Temperature Mechanical Properties (650°C)

Property	1.4962 / X12CrNiWTiB16-13	St17-13W (GE Spec)
0.2% Proof Strength (MPa)	≥180	≥220
Tensile Strength (MPa)	≥300	≥350
Elongation A5 (%)	≥25	≥18

Creep and Rupture Properties

1.4962 / X12CrNiWTiB16-13 Creep Performance

Creep Rupture Strength at 650°C:

- 10,000 hours: ≥ 120 MPa
- 100,000 hours: ≥ 90 MPa

Creep Rate: Typically $< 5 \times 10^{-8}$ %/h at 650°C under 100 MPa stress

St17-13W Creep Performance

- Shows superior creep resistance compared to standard grades
- 100,000 hour rupture strength at 650°C typically ≥ 100 MPa
- Warm working enhances creep resistance at intermediate temperatures

Physical Properties

Property	1.4962 / X12CrNiWTiB16-13
Density (g/cm ³)	7.9
Thermal Conductivity (W/m·K)	15 (at 20°C), 22 (at 700°C)
Specific Heat (J/kg·K)	500 (at 20°C), 650 (at 700°C)
Thermal Expansion (10 ⁻⁶ /K)	16.0 (20-100°C), 18.5 (20-700°C)
Electrical Resistivity (Ω·m)	0.95×10^{-6}
Elastic Modulus (GPa)	195 (at 20°C), 150 (at 700°C)

Heat Treatment

1.4962 / X12CrNiWTiB16-13 Heat Treatment

Solution Annealing (+A):

- Temperature: 1050-1150°C
- Cooling: Rapid cooling (water quenching preferred)
- Purpose: Dissolve carbides and achieve homogeneous austenitic structure

Stabilization Annealing (optional):

- Temperature: 850-950°C
- Cooling: Air cooling

- Purpose: Precipitate TiC and improve creep resistance

St17-13W (GE Specification) Processing

Warm Working (+HT):

- Working temperature: Typically 500-700°C
- Degree of deformation: Proprietary to GE
- Results in enhanced strength through work hardening

Final Condition: Warm Worked (+HT) per GE specifications

Processing Performance

Forging and Hot Working

- Recommended hot working temperature range: 1150-900°C
- Should be cooled rapidly after hot working to prevent carbide precipitation
- Warm working (for St17-13W) performed at 500-700°C

Machinability

- Machinability rating: ~40% of free-cutting steels
- Recommended tools: Carbide tools with chip breakers
- Cutting speeds: 20-40 m/min for turning operations
- Requires rigid setups due to work hardening tendency

Welding Characteristics

- **Weldability:** Fair with proper precautions
- **Recommended Processes:** GTAW (TIG), PAW (plasma arc)
- **Preheat:** Generally not required but 100-150°C helpful
- **Post-Weld Heat Treatment:** Full solution annealing recommended for critical applications
- **Filler Metals:** Matching composition or higher alloy grades (e.g., Ni-base alloys)

Microstructural Requirements

- **Austenitic Structure:** Fully austenitic after solution treatment
- **Carbide Precipitation:** Controlled distribution of TiC and M₂₃C₆
- **Grain Size:** ASTM 4-6 typically specified
- **Delta Ferrite:** Generally not permitted

- **Inclusions:** Controlled per ASTM E45 (Type A <2, Type B <1.5)

Equivalent Grades

Country/Standard	Equivalent Grade
Germany (DIN)	1.4962, X12CrNiWTiB16-13
USA (GE Spec)	St17-13W
USA (ASTM/UNS)	S66286
Japan (JIS)	SUH660
China (GB)	1Cr15Ni36W3Ti
Russia (GOST)	ЭИ787
Europe (EN)	X12CrNiWTiB16-13

Quality Control and Testing Requirements

- **Chemical Analysis:** Melt analysis required for all specified elements
- **Mechanical Testing:**
 - Tensile, impact, hardness testing required
 - Testing from center of cross-section for St17-13W
- **Non-Destructive Testing:**
 - Ultrasonic testing for critical applications
 - Dye penetrant inspection for surface defects
- **High-Temperature Testing:**
 - Elevated temperature tensile tests at service temperatures
 - Creep rupture testing for qualification

Recent Developments and Modifications

Recent updates to St17-13W specification (as seen in the GE document) include:

- Stricter control of sulfur content ($\leq 0.005\%$)
- Modified tungsten range (2.50-3.00%)
- Updated mechanical property requirements
- Enhanced documentation requirements (EN 10204 Type 3.1)